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CONTRACT NO. DE-AC05-86OR21548

RAFFINATE PIT AREA GROUNDWATER INVESTIGATION SAMPLING PLAN ADDENDUM 1: OFF-SITE GROUNDWATER INVESTIGATION

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI

MAY 2001 **REV. 0**

U.S. Department of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

Prepared by MK-Ferguson Company and Jacobs Engineering Group

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MORRISON KNUDSEN CORPORATION
MK-FERGUSON GROUP

Weldon Spring Site Remedial Action Project
Contract No. DE-AC05-86OR21548

Rev. No. 0

PLAN TITLE: Raffinate Pit Area Groundwater Investigation Sampling Plan Addendum 1: Off-Site Groundwater Investigation

APPROVALS

Groundwater Operable Unit Coordinator	4-27-01 Date
Environmental Safety and Health Manager	4/30/01 Date
Data Administration Coordinator	5/1/01 Date
Project Quality Manager	5/1/2001 Date
Deputy Project Director	5/1/01 Date

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Weldon Spring Site Remedial Action Project

Raffinate Pit Area Groundwater Investigation Sampling Plan Addendum 1: Off-Site Groundwater Investigation

Revision 0

May 2001

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U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations Office
Under Contract DE-AC05-86OR21548

ABSTRACT

The selected remedy for trichloroethylene (TCE) impacted groundwater at the chemical plant site authorizes active remediation using an in situ chemical oxidation process. The areal extent of TCE-impacted groundwater has not been fully delineated south of the raffinate pit area. A complete delineation is necessary to establish the boundaries for performance of the chemical oxidation process. Additional information regarding contaminant migration and possible volatile organic source areas will also be obtained during this investigation.

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1. INTRODUCTION

The selected remedy for groundwater at the chemical plant site authorizes active remediation using an in situ chemical oxidation process (Ref. 1). The in situ process will be performed as part of the interim groundwater remedial action to reduce trichloroethylene (TCE) concentrations to the maximum contaminant level (MCL) of 5 µg/l.

Additional monitoring wells were installed in February 2001 in an effort to delineate the areal extent of TCE impact (Figure 1-1). However, the extent of this impact was not completely delineated to the south of the raffinate pit area. A complete delineation is necessary to establish the boundaries for performance of the in situ chemical oxidation process.

1.1 Purpose and Scope

The *Raffinate Pit Area Groundwater Investigation Sampling Plan* (Ref. 2) was developed to provide the strategy for monitoring well installation and groundwater sampling activities to delineate the areal extent of TCE impact. This plan specified the drilling activities, hydrogeologic testing, monitoring well construction, sampling frequency, analytical parameters, and sampling protocol for this investigation.

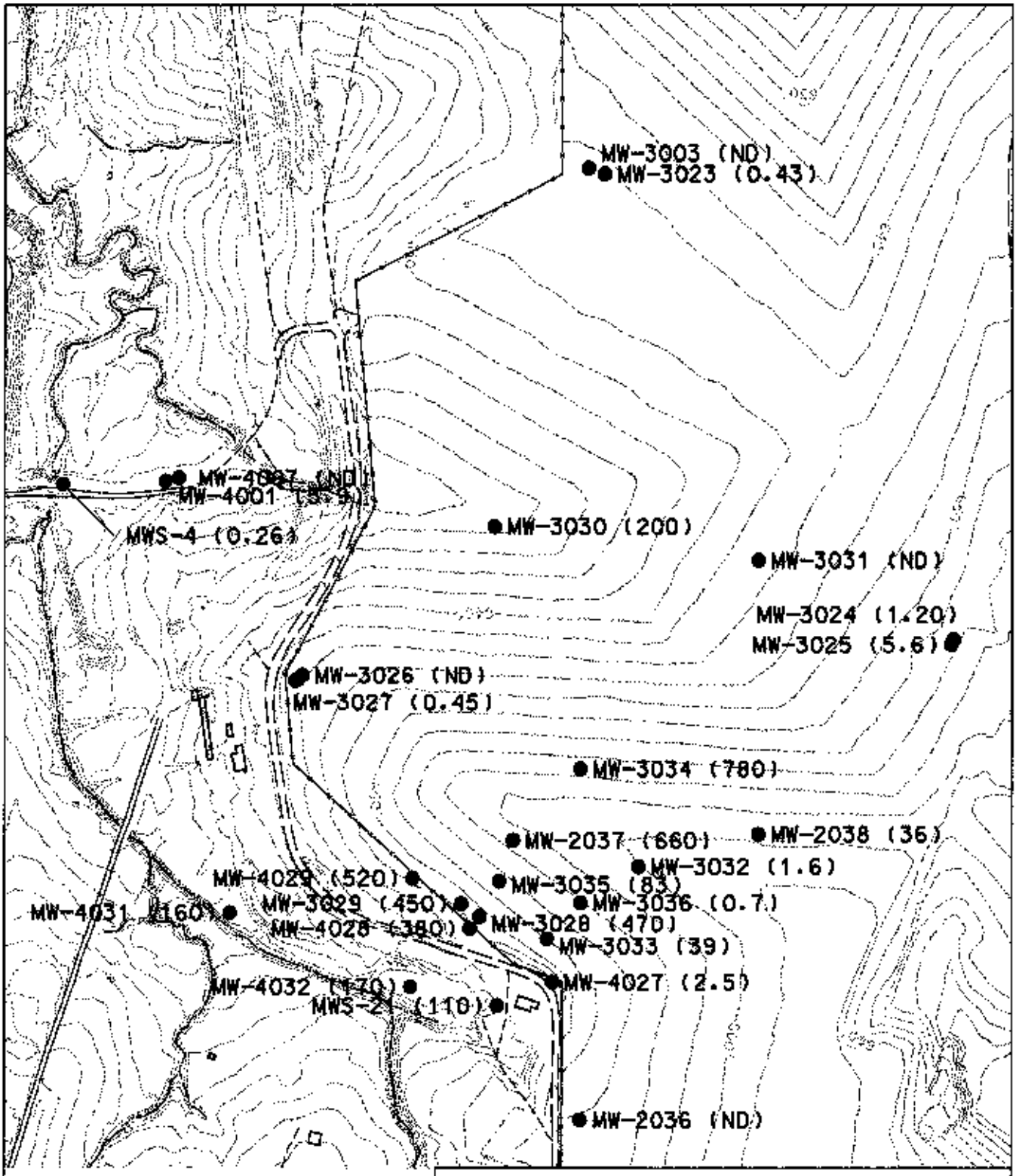
Addendum 1 details additional monitoring well installation and groundwater sampling activities associated with delineation of the areal extent of TCE impact south of the raffinate pit area. In addition to groundwater sampling, soil sampling at specified locations for volatile organic compounds is included in this addendum.

Data obtained from this additional investigation will be used to:

- Delineate the areal extent of TCE impact south of the raffinate pit area.
- Provide a better understanding of the contaminant migration pathways in this part of the site.
- Characterize potential source areas for volatile organic compounds in groundwater in the southwestern portion of the chemical plant.

1.2 Background

Drilling adjacent to Army well MW-S021 in March 2001 obtained saturated soil samples for WP-550A, *In Situ Chemical Oxidation of TCE – Bench Scale Testing*. At that time, bedrock topography data on this location indicated that bedrock was present 36.5 ft below the ground surface. Two borings were drilled within 30 ft of MW-S021, both encountering auger refusal on bedrock at 22 ft below the ground surface. Review of geologic logs in this area indicated that the



● – MONITORING WELL WITH TCE CONCENTRATIONS

DATA FROM Q1, 2001

N

0 300 600

SCALE FEET

AREA OF TCE IMPACT IN GROUNDWATER

FIGURE 1-1

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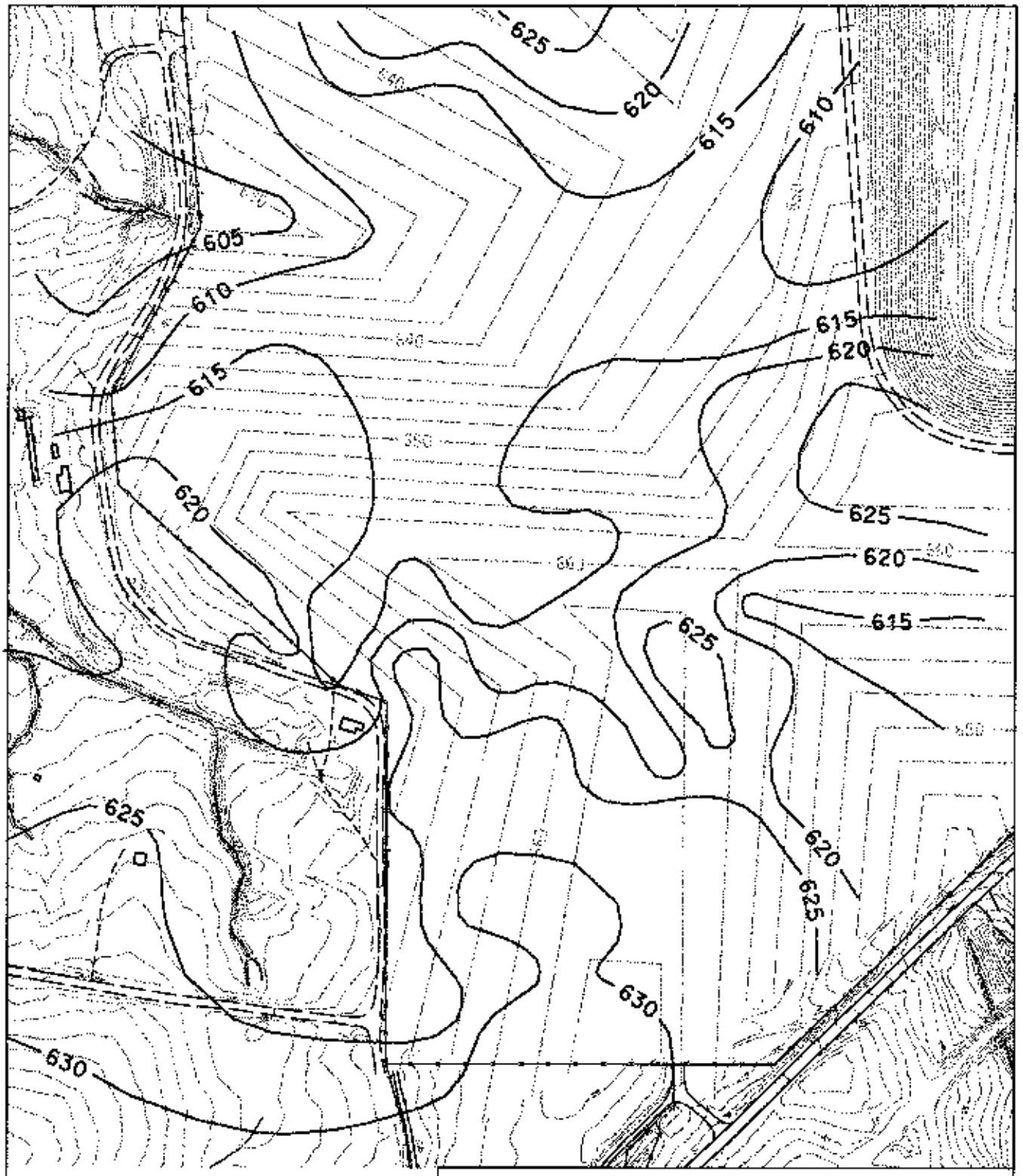
strongly weathered unit of the Burlington-Keokuk Limestone may not have been accounted for as the top of the bedrock. Drilling in support of the TCE delineation and the Groundwater Operable Unit field study indicated that the strongly weathered unit is a thick sequence of bedrock in the southwestern portion of the chemical plant. Auger refusal below the top of the rock surface was not unusual during these recent drilling activities. This may have lead to overestimated depths to bedrock.

Incorporating the top of rock elevations from the most recent two borings into the bedrock topography resulted in a significant change in the topography in the TCE impact area and the pump and treat field study area (Figure 1-2). Prior to obtaining this new data, the topography indicated a paleochannel sloping from north to south and ultimately following a present creek channel traversing to the west. Contaminant data and the groundwater surface supported the presence of the paleochannel in this area.

Revision of the bedrock topography using the new top of rock data still indicates the presence of the paleochannel, but it now slopes from south to north. A separate bedrock low follows the present creek channel flowing to the west. Contaminant concentrations obtained from the new TCE wells and field study observation wells support the conclusion that the flow through this feature is to the north. Also, observation of tracer dye originally injected in MW-2037 and now observed in MW-3034 supports preferential groundwater flow to the north rather than to the south.

A soil gas survey was performed in 1997 in an attempt to identify a subsurface TCE source area at the chemical plant (Ref. 3). Samples were taken at several depths, including at the top of the bedrock. The depths to the top of rock data from the soil gas survey fit the revised bedrock topography. It was noted in the soil gas report that probe refusal generally occurred at an elevation above the modeled top of bedrock surface. The locations where refusal was more than 10 ft higher than bedrock were in the area where the strongly weathered unit may not have been taken into account in modeling the bedrock topography southwest of MW-S021.

The soil gas report focussed on the presence of dense chlorinated solvents, primarily (TCE). The report discussed the occurrence of TCE as well as tetrachloroethylene (PCE), 1,2-dichloroethylene (DCE), and other breakdown products in soil gas samples. Detectable concentrations of TCE were identified in five of the sampling locations. Four of these locations are along the fenceline south of the TCE impact area. Only PCE was detected in one soil gas boring at a significant concentration. This sample was obtained from location SG-10, which is in close proximity to MW-4027. This well has exhibited PCE levels up to 25 ppb. Estimated values for the breakdown products have been detected sporadically in wells in the TCE impact area; however, the detection limits for these compounds were typically 10 ppb or greater.



— BEDROCK TOPO

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SCALE FEET

BEDROCK TOPOGRAPHY

FIGURE 1-2

REPORT NO.: DOE/OR/21548-881:1	DRAWING NO.: A/CP/041/0401	
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 4/26/01

Of interest in the report was the presence of benzene, toluene, ethylbenzene, and xylenes (BTEX) in a large number of the soil gas samples. Groundwater samples in the southwestern portion of the site have indicated low levels (generally estimated values) of these compounds intermittently since 1987. Detection limits have typically been greater than 10 ppb. The *Final Remedial Investigation for the Weldon Spring Training Area* (Ref. 4) indicated that subsurface soil samples were collected, and a soil gas survey was performed at the underground storage tank (UST) area on the east side of maintenance building S-28 approximately 1,300 ft south (upgradient) of MW-S021. The results of these studies indicated widespread residual contamination in the vicinity of the former USTs. Data from the subsurface soils indicated the presence of elevated toluene, xylenes, and methylene chloride. Groundwater impact was inferred by observation of a visible layer of product on top of the groundwater in the soil boring (Ref. 4).

2. HYDROGEOLOGIC INVESTIGATION

2.1 Monitoring Well Locations

Three groundwater monitoring wells (Figure 2-1) will be installed south of the trichloroethylene (TCE) impact area to delineate the extent of contamination in the weathered Burlington-Keokuk limestone and to determine the migration pathways in this area. Monitoring wells will be screened in the weathered portion of the Burlington-Keokuk Limestone at intervals exhibiting greatest permeability (as determined by packer tests) and/or visual evidence of groundwater movement (rock core logging). Previous characterization indicates most of the permeability in this unit is in the upper 15 to 20 ft (Ref. 3). If testing and visual inspection of the rock boring do not suggest a suitable location, the data will be evaluated and an alternate location will be suggested for installation of the monitoring well.

A summary of the well IDs, coordinates, and estimated depths is provided in Table 2-1.

Table 2-1 Well Locations and Installation Details

WELL ID	NORTHING	EASTING	TOTAL DEPTH[1]	DEPTH TO ROCK[1]
MW-4033	1041600	753100	35	20
MW-4034	1041355	753405	50	30
MW-4035	1040720	753325	60	40

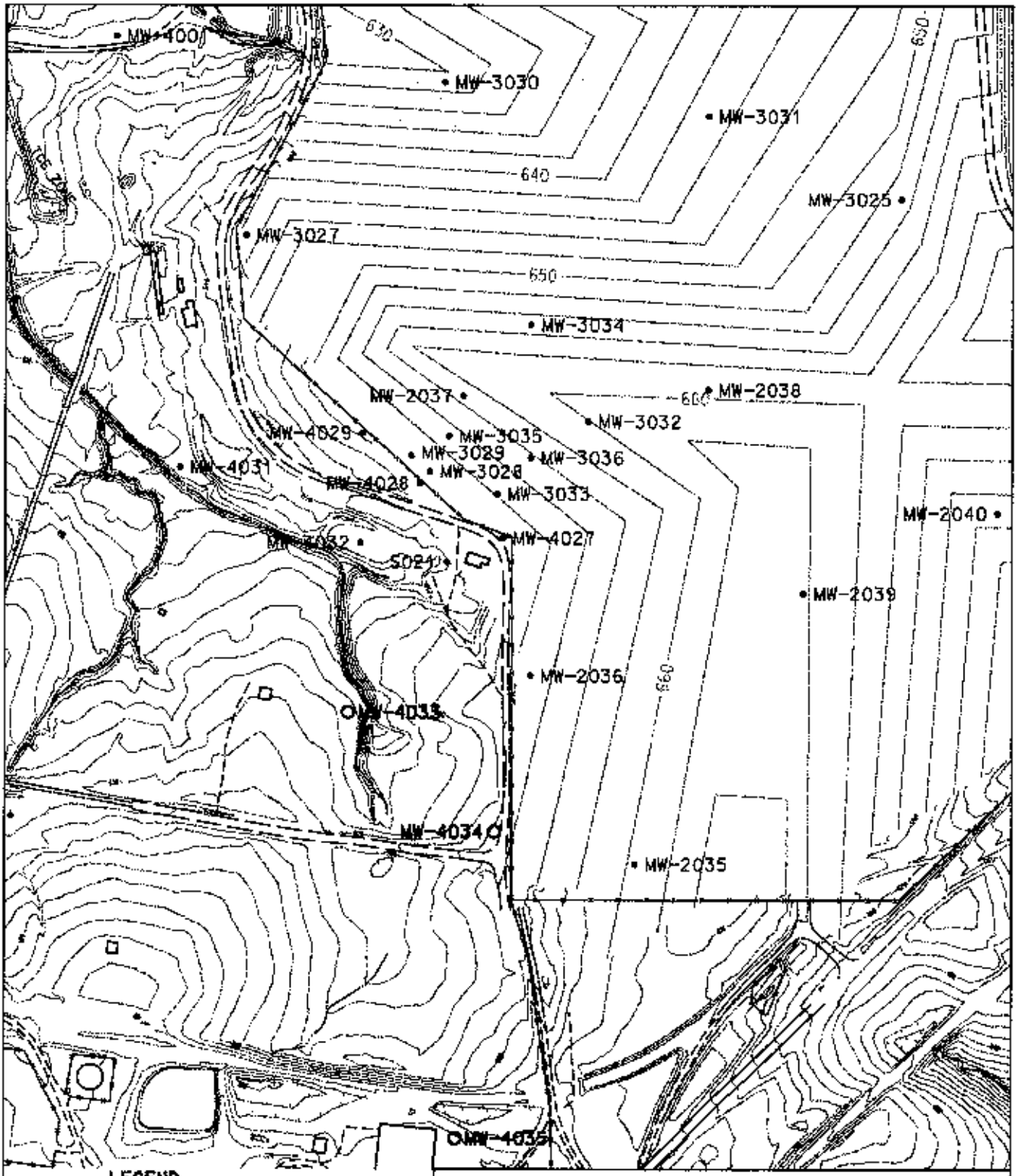
Note 1: Approximate depths – Installation depths will be determined in the field by the field geologist

2.2 Drilling Activities

Drilling will be performed as specified in the task description for Work Package 487A, *Subsurface Drilling Services* (Task 10, Rev. 0). The unconsolidated materials and bedrock will be continuously sampled for descriptive purposes.

2.3 Geologic Descriptions

The unconsolidated materials and the bedrock will be logged in accordance with procedure ES&H 4.4.7, *Soil, Rock Core, and Rock Chip Borehole Logging*. During description of the materials, emphasis will be placed on identifying evidence of groundwater movement (solutioning, staining, etc.).



LEGEND

• – EXISTING MONITORING WELL

O – NEW MONITORING WELL

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SCALE FEET

NEW MONITORING WELL LOCATIONS

FIGURE 2-1

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ORIGINATOR: RC	DRAWN BY: GLN	DATE: 4/26/01

2.4 Packer Testing

Packer tests will be performed on the bedrock portion of the borings during coring operations. Testing will be performed on 5-ft to 10-ft intervals to be determined by the field geologist during coring activities. The tests will be conducted using a packer inflated with inert gas. Generally, three to five tests of approximately 5-minute duration will be performed at each interval. It is recommended that pressures greater than 1 psi per foot of overburden not be used on test sections less than 10 ft. Increases in testing pressure should be on 5 to 10 psi increments. For each test, the influent pressure, average flow, length of test interval, and total head will be recorded on test logs.

2.5 Monitoring Well Construction

The three new monitoring wells are to be installed as specified below. The new monitoring wells will be constructed of 2-in. diameter stainless steel (316) materials with 0.010 in. continuous slot screens and 20-40 sand. The screened interval for each well will be 10 ft. Efforts will be made to intercept permeable zones based on visual inspection of rock core and/or packer test results. The field geologist will determine final screen placement at the time of installation based on hydrogeologic considerations. The wells will be installed in accordance with Work Package 487A (Task 10, Rev. 0) and the *Missouri Well Drillers' Law* (10 CSR 23).

- MW-4033 will be located at N1041600, E753100. It will have a total depth of approximately 35 ft. It is expected that this will include 20 ft of soil drilling and 15 ft of rock coring and reaming. The screen length will be 10 ft, with a filter pack interval of 22 to 35 ft below ground surface. The location of the well will be staked in the field by the Project Management Contractor (PMC).

- MW-4034 will be located at N1041355, E753405. It will have a total depth of approximately 50 ft. It is expected that this will include 30 ft of soil drilling and 20 ft of rock coring and reaming. The screen length will be 10 ft, with a filter pack interval of 35 to 50 ft below ground surface. The location of the well will be staked in the field by the PMC.

- MW-4035 will be located at N1040720, E753325. It will have a total depth of approximately 60 ft. It is expected that this will include 40 ft of soil drilling and 20 ft of rock coring and reaming. The screen length will be 10 ft, with a filter pack interval of 45 to 60 ft below ground surface. The location of the well will be staked in the field by the PMC.

2.6 Investigation Derived Wastes

All waste streams generated during these activities will be managed in accordance with ECDI-18, *Handling and Disposition of Site Generated Wastes*. Wastes generated during this activity will include soil and rock cuttings, drilling water, personal protective equipment, and miscellaneous trash, which will be handled as specified in the task description for Work Package 487A.

Soil and rock cuttings and drill water will be collected and dispositioned as described for this task in Work Package 487A. Handling of these materials will be the responsibility of each respective subcontractor. Dispositions will be approved by the PMC prior to transport of the materials.

2.7 Borehole Abandonment

If for any reason a borehole is not converted to a monitoring well, the borehole will be plugged in accordance with Procedure ES&H 4.4.4, *Subsurface Monitoring Device Plugging and Abandonment*, and 10 CSR 23, *Missouri Well Construction Rules*. Borings less than 10 ft deep will be backfilled with native soils. Borings greater than 10 ft deep will be backfilled with bentonite material, with compacted soil comprising the upper 2 ft of the backfill.

3. CONTAMINANT INVESTIGATION

3.1 Soil Sampling

3.1.1 Location

Soil samples will be collected at the MW-4035 location. Sample collection will be performed in accordance with Procedure ES&H 4.4.5, *Soil/Sediment Sampling*. Samples will be collected in 2.5-ft intervals from the ground surface to the top of bedrock.

3.1.2 Parameters

Soil samples will be analyzed for volatile organic compounds using method SW846. Samples will be placed in two 100-ml wide-mouth glass jars with no headspace. Samples will be placed in coolers with ice in the field. All containers will be labeled in accordance with procedure ES&H 4.1.1, *Numbering System for Environmental Samples and Sampling Locations*. Sample forms from ES&H 4.4.1 will be completed for each sample

3.1.3 Screening

Each sample will be screened for volatile organic compounds with a photoionization detector (PID). Trichloroethylene (TCE) has an ionization potential of approximately 9.5 election volts (eV); therefore, a lamp suitable for detection of this compound will be used for this screening.

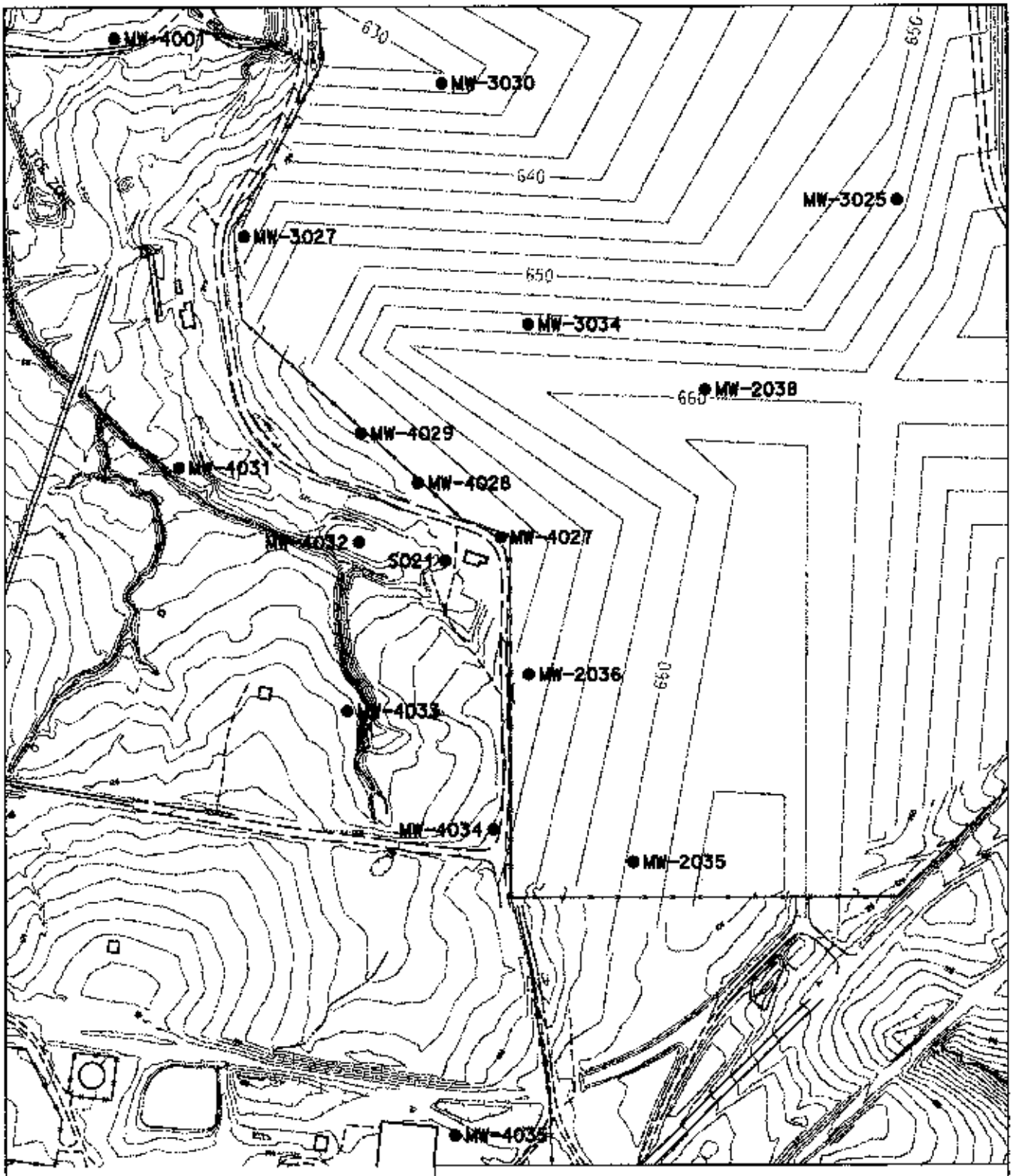
3.1.4 Equipment Decontamination

Equipment used at locations where soil samples are collected will be decontaminated prior to sampling and between samples in accordance with procedure ES&H 4.1.3, *Sampling Equipment Decontamination*. Split-spoon samplers will be washed using a non-phosphate soap and water and rinsed using distilled water. Augers will have gross contamination (mud) removed at the drill site and then high-pressure washed at a decontamination facility. Soil and water will be handled as specified in Section 2.6.

3.2 Groundwater Sampling

3.2.1 Locations

Samples will be collected from the three new monitoring wells as well as several existing wells in the area (MW-2035, MW-2036, MW-2038, MW-3025, MW-3027, MW-3030, MW-3034, MW-4001, MW-4027, MW-4028, MW-4029, MW-4031, MW-4032, and MW-S021) (Figure 3-1). Samples will be collected in accordance with procedure ES&H 4.4.1, *Groundwater*



LEGEND

● – MONITORING WELL

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0 300 600

SCALE FEET

GROUNDWATER SAMPLING LOCATIONS

FIGURE 3-1

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Sampling. Field parameters (pH, Eh, dissolved oxygen, and conductivity) will be measured at each location.

3.2.2 Parameters

Samples from the wells will be analyzed for volatile organic compounds using method SW846. Samples will also be analyzed for TCE, PCE, and 1,2-DCE specifying a lower detection limit of 1 µg/l. The 14 existing monitoring wells will be sampled during the first sampling event for the volatile organic compounds list. Baseline sampling for uranium, anions, metals, and nitroaromatic compounds will be performed at the new wells during the first sampling event.

The appropriate containers and preservation methods for each sample are summarized in Table 3-1. All containers will be labeled in accordance with procedure ES&H 4.1.1, *Numbering System for Environmental Samples and Sampling Locations*. Sample forms from ES&H 4.4.1 will be completed for each sample

Table 3-1 Sample Containers and Preservation for Groundwater

Parameter	Container	Preservation
Volatile Organic Compounds	2 – 40-ml, glass vials (no headspace) [3]	Cool (4°C) 2 drops HCL
PCE/TCE/DCE	2 – 40-ml, glass vials (no headspace) [3]	Cool (4°C) 2 drops HCL
Nitroaromatic Compounds	1 liter, amber glass [4]	Cool (4°C)
Uranium, total	250 ml, plastic	Nitric Acid (pH < 2)
Metals [1]	1 liter, plastic	Nitric Acid (pH < 2)
Anions [2]	1 – 1 liter, plastic 1 - 250 ml, plastic	Cool (4°C) Sulfuric Acid (pH < 2)

1 Metals (geochemical list)
2 Anions (chloride, fluoride, nitrate, and sulfate)
3 6 – 40-ml vials when QC required
4 3 liters when QC required

3.2.3 Sampling Frequency

The new monitoring wells will be sampled monthly for 3 months. These wells may be incorporated into the *Environmental Monitoring Plan* (Ref. 5) depending on the results of this investigation. The 14 existing wells will be sampled during the first round of sampling for this groundwater investigation. Additional sampling may be performed at the existing wells based on the results of the initial sampling.

4. QUALITY CONTROL

The Project Management Contractor (PMC) at the Weldon Spring Site Remedial Action Project (WSSRAP), has developed the *Environmental Quality Assurance Project Plan* (EQAPjP) (Ref. 5) to guide all environmental activities conducted at the WSSRAP in accordance with the U.S. Environmental Protection Agency guidelines. The *Sample Management Guide* (Ref. 6) has been developed following the guidelines listed in the EQAPjP. This guide establishes the approach to sample planning, collection, and data analysis.

4.1 Chain-of-Custody

Chain-of-Custody forms will be completed and placed in the sample coolers in accordance with procedure *ES&H 4.1.2, Initiation, Generation, and Transfer of Environmental Chain-of-Custody*.

4.2 Analytical Procedures

The on-site laboratory conducting the radiological analysis for this sampling effort uses approved methodologies in accordance with site standard operating procedures (SOPs).

The off-site quantitative laboratories conducting radiological and chemical analysis have submitted controlled copies of their site-specific quality assurance project plans (QAPjP) and SOPs. The plans and SOPs have been reviewed and accepted by the PMC. The WSSRAP and contract laboratory SOPs comply with the accepted standards and methodologies for performing analytical processes, operations, and activities. The laboratory QAPjPs and SOPs specify quality control requirements to demonstrate the precision, representativeness, and accuracy of the analytical data.

4.3 Quality Control Samples

Quality control samples will be collected to ensure consistent and accurate performance of sample collection and laboratory analysis. Table 4-1 provides a summary list of the quality control samples that will be collected to support this effort.

4.4 Data Evaluation

Data packages received from the off-site contract laboratories undergo several processes to evaluate the quality of the data. When data are first received, copies will be distributed to the Verification/Validation Group and data users for review as described in the following sections.

Table 4-1 Field Quality Control Sample Summary

QC SAMPLE TYPE	FREQUENCY	PURPOSE
Field Replicate (on-site and off-site)	1 per 20 samples	Assess matrix, intralaboratory, and field operations variability
Matrix Spike/Matrix Spike Duplicate or Matrix Duplicate (off-site only)	1 per 20 samples	Assess matrix and possible intralaboratroy variability
Equipment Blanks	1 per 20 samples	Assess effectiveness of decontamination process
Trip Blanks (VOA analysis only)	1 per shipment	Assess possible introduction of VOAs during handling, transportation, and receipt at the laboratory.

4.4.1 Data Verification

Analytical results received from the laboratory will be reviewed in accordance with procedure ES&H 4.9.1, *Environmental Monitoring Data Verification*. The following factors will be evaluated to verify if a sample has been properly handled according to WSSRAP protocol:

- Chain-of-Custody
- Holding Times
- Sample preservation requirements
- Sample analysis request form
- Quality control samples
- Laboratory receipt forms

4.4.2 Data Review

The data package will be distributed to the data users for review. The data will be reviewed to identify discrepancies in the field quality control samples, inconsistencies with characterization data, and apparent abnormalities. Deficiencies identified by data users will be reported to the Verification Group. Data users may request validation of any data that appear to be of questionable quality. This review will be done in accordance with procedure ES&H 1.1.7, *Data Review and Above-Normal Data Reporting*.

4.4.3 Data Validation

Randomly selected laboratory data and data selected by verification personnel or data users will undergo thorough review of the analytical process in accordance with procedure ES&H 4.9.2, *Environmental Monitoring Data Validation*. The Validation Group will conduct these reviews.

The validation procedure will provide a consistent means for reviewing and evaluating the data resulting from laboratory analyses and will provide a consistent means of documenting the evaluation and reporting the usefulness of the data to data users. This will be accomplished by a thorough review of the analytical data using laboratory records to assess laboratory conformance to quality control criteria, data quality requirements for data quality objectives, and procedural requirements.

5. DATA EVALUATION

Hydrogeologic data obtained from this sampling will be incorporated into the existing database for bedrock topography and site geology. Static water level measurements from the four new well as well as nearby wells will be measured during each sampling event and will be incorporated into the site wide static water level measurement program. These data will be used determine groundwater flow directions and preferential flow pathways in this area.

Analytical data will be used to delineate the extent of TCE groundwater impact in this area for future remedial activities. Incorporation of these wells into the groundwater monitoring program for the site will assist in monitoring contaminant trends due to scheduled remedial activities.

Analytical data from the soil samples will be used to determine if a potential source for volatile organic compounds is present south of the chemical plant area. Soil data will be compared to the groundwater data to identify possible contaminant source areas.

A report detailing field activities, geologic information, and initial analytical data will be prepared for this investigation. Deviations or modifications to this plan will be discussed.

6. REFERENCES

1. U.S. Department of Energy. *Interim Record of Decision for Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site*. No Rev. DOE/OR/21548-798. Prepared by Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project. Weldon Spring, MO. September 2000.

2. MK-Ferguson Company and Jacobs Engineering Group. *Raffinate Pit Area Groundwater Investigation Sampling Plan*. Rev. 0. DOE/OR/21548-881. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. February 2001.

3. MK-Ferguson Company and Jacobs Engineering Group. *Soil Gas Sampling Results for the Groundwater Operable Unit Weldon Spring, Missouri*. DOE/OR/21548-719. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. June 1998.

4. Environmental Science and Engineering, Inc. *Material Test Report (Draft) Sludge Sampling and Testing Services, Weldon Spring Storage Site, Missouri*, Subcontract No. 14501-AA-SC-46. Prepared for Bechtel National, Inc., in cooperation with Monteagle, Inc., Environment and Energy Consultants, and Reitz & Jens, Inc. August 9, 1983.

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6. MK-Ferguson Company and Jacobs Engineering Group. *Environmental Quality Assurance Project Plan*. Rev. 5. DOE/OR/21548-352. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. November 2000.

7. MK-Ferguson Company and Jacobs Engineering Group. *Sample Management Guide*. Rev. 2. DOE/OR/21548-499. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. June 2000.

PROCEDURES

EDCI-18, *Handling and Disposition of Site Generated Wastes*
ES&H 1.1.7, *Reporting Above-Normal Values from Environmental Monitoring Networks*
ES&H 4.1.1, *Numbering System for Environmental Samples and Sampling Locations*
ES&H 4.1.2, *Initiation, Generation, and Transfer of Environmental Chain-of-Custody*
ES&H 4.1.3, *Sampling Equipment Decontamination*
ES&H 4.4.1, *Groundwater Sampling*
ES&H 4.4.4, *Subsurface Monitoring Device Plugging and Abandonment Procedure*
ES&H 4.4.5, *Soil/Sediment Sampling*
ES&H 4.4.7, *Soil, Rock Core, and Rock Chip Borehole Logging*

ES&H 4.9.1, *Environmental Monitoring Data Verification*
ES&H 4.9.2, *Environmental Monitoring Data Validation*

MK-Ferguson Company
Weldon Spring Site Remedial Action Project

TRANSMITTAL OF CONTRACT DELIVERABLE

Date: **May 7, 2001** Transmittal No.: **CD-0262-00**

Title of Document: **Raffinate Pit Area Groundwater Investigation Sampling Plan Addendum 1: Off-Site Groundwater Investigation**

Doc. Num.: **881:1** Rev. No.: **0** Date of Document: **May 2001**

Purpose of Transmittal: Request for Department of Energy acceptance of contract deliverable.

In compliance with the Project Management Contract, MK-Ferguson Company hereby delivers the attached document to the U.S. Department of Energy, Weldon Spring Site Office. The document has been reviewed and approved by Project Management Contractor management.

The document will be considered accepted unless we receive written notification to the contrary within 30 days of the date of this transmittal.

Number of copies transmitted: ~~One~~ Seven

Douglas E. Steffen
Project Director